# APPENDIX G

# HYDROELECTRIC POWER PLANT PERSONNEL TRAINING PROGRAM

## TABLE OF CONTENTS

SPECIALIZED TRAINING - OPERATOR

HYDROELECTRIC POWER PLANT PERSONNEL TRAINING PROGRAM
CORRESPONDENCE COURSES

TRAINEE IA AND IB

| ICS Course | Text Titles | Units |
|---|---|---|
| | TRAINEE IA | |
| 2750 A-F | Practical Arithmetic | 6 |
| 4210 A-C | Electricity | 3 |
| 6635 | Electrical Blueprint Reading | 1 |
| 2001 | Introduction to Electronics | 1 |
| 6719 A-B | Elements of Print Reading | 2 |
| 2002 A-B | Electronics | 2 |
| | SUB-TOTAL | 15 |
| | TRAINEE IB | |
| 2468 | Formulas | 1 |
| 6426 A-B | Principles of Mechanics | 2 |
| 2508 | OSHA: Occupational Safety and Health Act | 1 |
| 2469 A-B | Algebra | 2 |
| 2509 A-E | Industrial Safety | 5 |
| 6718 A | Hydraulic Turbines | 1 |
| 6589 A | Electric Power Generating Station | 1 |
| | Sub-Total | 13 |
| | TOTAL | 28 |

PLANT EQUIPMENT STUDY OUTLINE

TRAINEE IA

I. Safety:

A. Clearance Procedure
1. Types of Clearances
2. Types of Cards
3. Switching Orders

B. Code Call
1. Operation

C. Equipment Safety Measures
1. Wheel Pit
2. Remote Sites
3. Switchyard

D. Hazardous Areas
1. Battery Room
2. Oil Storage
3. Fixed CO Protected Spaces
4. Metal Enclosed Switchgear
5. Tailrace and Gate Decks
6. Remote Sites (microwave repeater site, etc.)

II. Electrical/Electronic Diagrams

A. Symbols
1. Electrical
2. Electronic

B. Use

III. Mechanical Prints

A. Symbols
B. Use

IV. Main Generating Units

A. Generator
1. Main Components
2. Rating
3. Operations

B. Turbine
1. Main Components
2. Rating
3. Operations

V. Fire Fighting Equipment and Alarms

A. Types of Fires
B. Types of Fire Fighting Equipment
C. Alarms

VI. Definitions

A. Hydraulic
B. Electrical
C. Power

VII. Soldering Techniques

A. Mechanical Strength
B. Electrical Connection
C. Selection of Materials

## PLANT EQUIPMENT STUDY OUTLINE

## TRAINEE IB

I. Safety and First Aid

A. $CO_2$
1. Hazards
2. Safety Precautions
B. Emergency breathing Equipment
1. Type
2. Location
C. Protective Equipment
1. Ear
2. Eye
3. Foot

II. Turbine and Gates

A. Types
1. Turbine
2. Gates
B. Operation
1. Turbine
2. Gates
C. Construction

1. Gates

III. Miscellaneous Electrical

A. Circuit Breakers
1. Rating
2. Operating Mechanism
3. Control Circuits

B. Motor Operated Disconnects
1. Rating
2. Operation
3. Control Circuits

IV. Air Systems

A. Station Air
1. Operating Pressure

B. Brake Air
1. Operating Pressure

C. Governor Air
1. Operating Pressure

V. Air Compressors

A. Cooling
1. Methods

B. Systems
1. Diagrams

VI. $CO_2$ System

A. Uses and Hazards
1. Safety Precautions

B. Systems
1. Generator
2. Oil
3. Other

## CORRESPONDENCE COURSES

## ELECTRICIAN TRAINEE IIA AND IIB

| ICS Course No. | Test Titles | Units |
|---|---|---|
| | **TRAINEE IIA** | |
| 4410 | Getting Started As An Electrician | 1 |
| 6589 B | Electric Power Generating Stations | 1 |
| 6634 A-B | Electrical Schematic Diagrams | 2 |
| 2443 | Going Metric | 1 |
| 5567 | Practical Geometry and Trigonometry | 1 |
| 5004 A | Benchwork - Part 1 | 1 |
| 3500 A | Measuring Instruments | 1 |
| 2469 C-E | Algebra | 3 |
| 5011 | Elements of Chemistry (Reference Only) | 1 |
| 2007 A | Solid State Circuits | 1 |
| 6238 A-B | Industrial Accident Prevention | 2 |
| | | Sub-Total 15 |
| | **TRAINEE IIB** | |
| 4030 A-B | D-C Machines | 2 |
| 6687 | D-C Generators and Motors | 1 |
| 2007 B-C | Solid State Circuits | 2 |
| 6718 B | Hydraulic Turbines | 1 |
| 1842 A-C | Reading Architect's Blueprints | 3 |
| 4031 | Alternators | 1 |
| 3521 A-B | Drilling | 2 |
| 2246 A-B | Erecting | 2 |
| 2542 | Fasteners | 1 |
| | | Sub-Total 15 |
| | | TOTAL 30 |

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IIA

I. Clearances

- A. Protective Cards
- B. Hold Orders
- C. Placing of Protective Grounds

II. Switching

- A. Switching Order
- B. Precautions When Switching

III. Water Systems

- A. Definitions
- B. Raw Water System
- C. Potable Water System

IV. Direct Current Systems

- A. Description of Systems
- B. Batteries
  1. Types
  2. Charges
- C. Emergency Lighting

V. Excitation Systems

- A. Description
- B. Purpose
- C. Operation

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IIB

I. Station Service

- A. Precautions
- B. Description
- C. Operation

II. Power Transformers

- A. Ratings
- B. Purpose
- C. Precautions

III. Governors

- A. Purpose
- B. Type
- C. Operation
  1. Oil Pressure
  2. PMG
  3. Overspeed

IV. Limits, Alarms, and Name Plates

- A. Load Limits
- B. Temperature Limits
  1. Generators
  2. Transformers
- C. Name Plate Data
  1. Generators
  2. Exciters
  3. Transformers
- D. Annunciation
  1. Description

V. Protective Relays

- A. Description
- B. Purpose
- C. Operation

## CORRESPONDENCE COURSES

## ELECTRICIAN TRAINEE III A AND III B

| ICS Course No. | Text Title | Units |
|---|---|---|
| | **TRAINEE IIIA** | |
| 6720 A-B | Reading Shop Prints | 2 |
| 40108 A-C | Electricity and Magnetism | 3 |
| 4040 | Transformers | 1 |
| 4042 | Distribution and Power Transformers | 1 |
| 6613 | Switchgear | 1 |
| 4146 A-C | Electrical Measuring Instruments | 3 |
| 6698 | A-C Motors, Generators, and Rectifiers | 1 |
| 6631 A-B | A-C Motor Repair | 2 |
| 4220 A-B | Repairing D-C Motors and Generators | 2 |
| | | Sub-Total 16 |
| | **TRAINEE IIIB** | |
| 4033 | Fractional Horsepower Motors | 1 |
| 4034 | Repairing Fractional Horsepower Motors | 1 |
| 6699 A-C | Industrial Motor Control | 2 |
| 6585 | Reconnecting Induction Motors | 1 |
| 6682 | Electric Lamps | 1 |
| 4305 | Lighting Control | 1 |
| 4402 A-B | Conduit and Conductors | 2 |
| 4300 A-C | Electric Wiring | 3 |
| 4343 | Storage Batteries | 1 |
| | | Sub-Total 14 |
| | | TOTAL 30 |

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IIIA

I. CLEARANCE PROCEDURES

A. This will cover every thing pertaining to clearance procedures.

II. TEST INSTRUMENTS

- A. Megger
  - 1. Theory of operation
  - 2. Where used
- B. Multimeter
  - 1. Theory of operation
  - 2. Where used
- C. Clamp on Ammeter
  - 1. Theory of operation
  - 2. Where used
- D. Other types

III. SELSYN SETS

- A. Theory of operation
- B. Where utilized
- C. Operation
- D. Maintenance

IV. DISCONNECT SWITCHES

- A. Types
  - 1. Manual
    - a. Ratings
    - b. Operation
    - c. Contact Surfaces
  - 2. Motor Operated
    - a. Control Circuits
    - b. Operating Mechanism
    - c. Contact Surfaces

V. INTERLOCKS

- A. Purpose and Types
  - 1. Generators
  - 2. Breakers
  - 3. Discounts
  - 4. Metal clad switchgear
  - 5. Control circuits (relay, etc.)
  - 6. Governors

VI. AIR CIRCUIT BREAKERS - 15 KV AND 480 V

- A. Type
  - 1. 13.8 KV ACB
    - a. Operation (Prints)
    - b. Inspection
    - c. Maintenance
  - 2. 480 v ACB
    - a. Operation
    - b. Inspection
    - c. Maintenance
  - 3. Molded Case Breakers
    - a. Tests
    - b. Overloads
    - c. Maintenance

VII. POWER TRANSFORMERS

- A. Main Transformers
  - 1. Description
  - 2. $N_2$ Blanket
  - 3. Alarms
  - 4. Cooling (number pumps, power supply, water supply, coolers, etc.)
  - 5. TRO's
- B. Station Service Transformers
  - 1. Description
  - 2. Cooling

VIII. TRIPPING TESTS

- A. Methods
- B. Safety

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IIIB

I. ANNUNCIATOR SYSTEM

- A. Components
  - 1. Relays
  - 2. Trouble Contacts
  - 3. DC Supply
- B. Schematic Diagrams
- C. Maintenance

II. PREVENTIVE MAINTENANCE

- A. Responsibilities
- B. Purpose
- C. Record Keeping

III. ELECTRICAL MAINTENANCE

- A. Insulating Materials
  - 1. Tapes
  - 2. Varnish
  - 3. Others
- B. Protective Coatings
  - 1. Varnish
  - 2. Phenolic

IV. FLOW METERS

- A. Operation
- B. Testing
- C. Adjustment
- D. Calibration
- E. Maintenance

V. CODE CALL SYSTEM

- A. Description
- B. Operation
- C. Maintenance

VI. OCB's/GCB's

- A. Description
  - 1. Operating Mechanism
  - 2. Bell Crank, Operating Rod, Tail Spring, Trip Free
  - 3. Control Circuit
  - 4. Interrupter
  - 5. X and Y Relays
  - 6. Pressure Switches
- B. Maintenance
  - 1. Inspection
  - 2. Breaker Timer
  - 3. Draining and Filling with Oil/$SF_6$

VII. INSULATING OIL/GAS

- A. Type
- B. Where Used
- C. Purifying Insulating Oil
  - 1. Filter Press
  - 2. Centrifuge
- D. Insulating Oil/Gas Flow Diagram
- E. Testing of Insulating Oil/Gas

VIII. STORAGE BATTERIES

- A. Description
  - 1. Number of Cells
  - 2. Type of Cells
  - 3. Maintenance
  - 4. How Connected
- B. Chemical Action
  - 1. When in Normal Use
  - 2. When Charging
  - 3. Overcharging
  - 4. Safety Precautions

IX. BATTERY CHARGERS

- A. Description
  - 1. Type
  - 2. Characteristics
  - 3. Power Supply
  - 4. Capacity
- B. Control
  - 1. How Operated
  - 2. Control Circuit (DC/AC)

## CORRESPONDENCE COURSES

## ELECTRICIAN TRAINEE IV-A AND IV-B

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IVA** | |
| 6538 A-B | Protective Relaying | 2 |
| 4312 | Electric Space Heating | 1 |
| 2531 A-B | Lubrication | 2 |
| 2602 | Bearings and Seals | 1 |
| 5177 | National Electric Code | 1 |
| 4368 | Voltage Regulators for Generators | 1 |
| 6686 | Local Distribution of Electric Power | 1 |
| 5959 A-B | Underground Power Systems | 2 |
| 2020 | Basic Electronic Components and Schematics | 1 |
| 2021 | Understanding and Using Electronic Diagrams | 1 |
| 6636 | Controls For Air Conditioning | 1 |
| | | Sub-Total 14 |
| | **TRAINEE IVB** | |
| 4019 A-B | Electric Power Measurements | 2 |
| 4342 | Efficiency Tests | 1 |
| 4341 | Industrial Motor Applications | 1 |
| 2089 A-H | Electronics in Industry | 8 |
| 6617 | Inductance and Capacitance | 1 |
| 6235 A | Inventory Control | 1 |
| | | Sub-Total 14 |
| | | TOTAL 28 |

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IVA

I. CLEARANCE PROCEDURES AND SAFETY

II. RELAYS

- A. Types
- B. Zone of Protection
- C. Generator
- D. Turbine
- E. Transformer
- F. Lines

III. LIGHTING ARRESTERS AND HIGH VOLTAGE FUSES

- A. Theory of Operation
- B. Breakdown and Reseal Voltages
- C. Maintenance and Inspection

IV. HEATING, VENTILATING AND AIR CONDITIONING

- A. Electrical Operation (Prints)
- B. Mechanical Operation (Flow Diagrams)
- C. Maintenance

V. POWERHOUSE CRANE

- A. Electrical
  1. Source of Supply
  2. Controls
  3. Operation
  4. Limit Switches

V. POWERHOUSE CRANE (Cont.)

- B. Mechanical
  1. Hoist
  2. Cable Drums
  3. Cables
- C. Capacity
  1. Main Hoists
  2. Auxiliary Hoists
- D. Maintenance

VI. CARRIER CURRENT

- A. Definition
- B. How Used in Relaying

# PLANT EQUIPMENT STUDY OUTLINE

## ELECTRICIAN TRAINEE IV B

NOTE: Since this is the "topping out" examination, the study questions for phases 1A, 1B, 2A, 2B, 3A, 3B and 4A are to be included and selected questions will be asked to determine the understanding and retention of all previous training.

I. MAIN GENERATORS (complete)

- A. Starting, Stopping (Automatic, Using Print)
- B. Complete Unit Description (Using Prints)
- C. Voltage Regulation (Print)

II. RECORDERS: TEMPERATURE, LOAD, AND FREQUENCY

- A. Theory of operation
  1. Measuring Circuits
  2. Secondary Functions
- B. Maintenance
  1. Adjustments
  2. Cleaning
  3. Calibration

III. SUPERVISORY SKILLS

- A. Planning, Organizing, Working Knowledge of Job
- B. Performance Appraisals and Job Description
- C. Training and Development

IV. TELEPHONE SYSTEM

- A. Operation
- B. Maintenance

V. SPECIALIZED SAFETY TECHNIQUES

- A. Cleaning generators, polishing shafts, scaffolds, ladders, safety belts, etc.

VI. TELEMETERING

- A. Principles
- B. Types
  1. Voice
  2. Metering

VII. REMOTE CONTROL EQUIPMENT

- A. Principles and Features of Operation
- B. Maintenance

VIII. LINE RELAYS AND GROUND DETECTOR SYSTEMS

- A. Principles of Operation of Line Relays
- B. Ground Detector Systems (AC and DC)

IX. MAINTENANCE OF PORTABLE POWER TOOLS

- A. Inspection
- B. Preventative Maintenance
- C. Recording Data

X. GANTRY CRANE

- A. Description
- B. Operation
- C. Maintenance

XI. INSPECTIONS

A. Motor Control Centers
   1. Breakers
   2. Contractors
   3. Space Heaters
   4. Wiring
   5. Terminal Blocks

B. Motors
   1. Windings
   2. Commutators and Slip Rings
   3. Wiring
   4. Insulation

C. Generators
   1. Exciters
   2. Speed Switches
   3. Windings
   4. Surge Protection
   5. ACB

D. Recording Data

E. Clearance Procedure

## CORRESPONDENCE COURSES

## ELECTRONICS MECHANIC TRAINEE IIA AND IIB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IIA** | |
| X0105-X0111 | Practical Math and Measurements | 7 |
| X0507 | Electronic Drawings | 1 |
| X0606,X0608,X0609 | Industrial Materials and Components | 3 |
| XO401-X0404 | Hand and Power Tools | 4 |
| A0206 | Rectification and Electronic Devices | 1 |
| A0301-A0306 | Electrical Measurements and Instruments | 6 |
| B0101-B0106 | Electronic Measurements and Instruments | 6 |
| | | Sub-Total 28 |
| | **TRAINEE IIB** | |
| B0201-B0204 | Reactive Circuits | 4 |
| B0301-B0306 | Electronic Components | 6 |
| B0401-B0408 | Basic Electronic Circuits | 8 |
| 6660 | Radio Communications Fundamentals | 1 |
| 6491 | Radio-Electronic Telemetry | 1 |
| 6511 A-C | Two-Way Radio Systems | 3 |
| 2173 | Transmitter Tests and Measurements | 1 |
| 6515 | Radio-Frequency Circuits | 1 |
| 5801 | Antennas and Radiation | 1 |
| | | Sub-Total 26 |
| | | TOTAL 54 |

## PLANT EQUIPMENT STUDY OUTLINE

## ELECTRONICS MECHANIC TRAINEE IIA

I. Clearance Procedures

II. Hand Tools

III. Definitions - Electronic, Electrical

IV. Diagrams - Electronic, Electrical, Telephone

V. Power Supplies

- A. Batteries
- B. Chargers
- C. A-C Power Supplies

D. Rectifiers

VI. Oscillator Circuits

VII. Test Equipment

A. Multimeters
B. Oscilloscope
C. Grounding and Insulation

VIII. Radio Installation, Vehicle

PLANT EQUIPMENT STUDY OUTLINE

ELECTRONICS MECHANIC TRAINEE IIB

I. Radios

A. AM
B. FM
C. SSB

II. Microwave

III. Public Address Systems

IV. Lightning Protection

V. Test Equipment - Includes Safety

VI. Cables - RF, Audio, Fiber Optic, Telephone

CORRESPONDENCE COURSES

ELECTRONICS MECHANIC TRAINEE IIIA AND IIIB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | TRAINEE IIIA | |
| B0501-B0508 | Electronic Systems | 8 |
| B0601-B0606 | Troubleshooting Electronic Equipment and Systems | 6 |
| B0701-B0707 | Pulse Circuits | 7 |
| | Sub-Total | 21 |

TRAINEE IIIB

| | | |
|---|---|---|
| B0801-B0808 | Logic Circuits | 8 |
| B0901-B0906 | Linear and Digital Integrated Circuits | 6 |
| B1001-B1005 | Basic Industrial Computer Systems | 5 |
| B1101-B1104 | Introduction to Microprocessors | 4 |
| | Sub-Total | 23 |
| | TOTAL | 44 |

PLANT EQUIPMENT STUDY OUTLINE

ELECTRONICS MECHANIC TRAINEE IIIA

I. Basic Television Systems, Closed Circuit (CCTV)

II. Alarm Systems

- A. Intrusion
- B. System Failure

III. Telephone Systems

- A. PBX
- B. Outside Lines
- C. Code Call

IV. Preventative Maintenance

V. Troubleshooting

VI. Specialized Test Equipment - Includes Safety

PLANT EQUIPMENT STUDY OUTLINE

ELECTRONICS MECHANIC TRAINEE IIIB

I. Hydrological, Meteorological, and Water Quality Systems

II. Carrier Current Equipment

III. Digital Techniques

IV. Digital Test Equipment (Specialized) - Includes Safety

V. Supervisory Controls

## CORRESPONDENCE COURSES

## ELECTRONICS MECHANIC TRAINEE IVA AND IVB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IVA** | |
| B1201-B1208 | Microprocessor Applications | 8 |
| B1301-B1309 | Electronic Instrumentation and Control | 9 |
| | Sub-Total | 17 |
| | **TRAINEE IVB** | |
| B1401-B1405 | Industrial Electronic Circuit Applications | 5 |
| B1501-B1505 | Basic Industrial Electronic System Applications | 6 |
| B1601-B1606 | Advanced Troubleshooting Techniques | 5 |
| | Sub-Total | 16 |
| | TOTAL | 33 |

## PLANT EQUIPMENT STUDY OUTLINE

## ELECTRONICS MECHANIC TRAINEE IVA

I. Advanced Microwave Systems

- A. Radio Units
- B. Antenna and Waveguide Accessories
- C. Multiplex

II. Test Equipment, Microwave - Includes Safety

III. Special Project Assignment

IV. Microprocessors and Microcomputers

V. Testing and Troubleshooting Microprocessors and Microcomputers

VI. Television Surveillance Systems

PLANT EQUIPMENT STUDY OUTLINE

ELECTRONICS MECHANIC TRAINEE IVB

I. Special Project Completion

II. Elementary Programming and PC

III. Antennas and Towers

IV. Supervisory Skills

Upon completion of this phase, the oral examination will include work and study requirements for Phase IV B and all previous work and study areas.

## CORRESPONDENCE COURSES

## MECHANIC TRAINEE IIA AND IIB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IA** | |
| 6718 B | Hydraulic Turbines | 1 |
| 6634 A-B | Electrical Schematic Diagrams | 2 |
| 2443 | Going Metric | 1 |
| 5567 | Practical Geometry and Trigonometry | 1 |
| 5004 A | Benchwork - Part 1 | 1 |
| 3500 A | Measuring Instruments | 1 |
| 2469 C-E | Algebra | 3 |
| 6687 | D. C. Generators and Motors | 1 |
| 5011 | Elements of Chemistry (Reference Only) | 1 |
| 6238 A-B | Industrial Accident Prevention | 2 |
| | | Sub-Total 14 |
| | **TRAINEE IIB** | |
| 1842 A-C | Reading Architect's Blueprints | 3 |
| 6718 C | Hydraulic Turbines | 1 |
| 5023 | Fundamentals of Grinding | 1 |
| 6151 | Fundamentals of Welding | 1 |
| 6152 A-B | Practical Metallurgy for Welders | 2 |
| 3521 A-B | Drilling | 2 |
| 2246 A-B | Erecting | 2 |
| 2542 | Fasteners | 1 |
| 6720 A-B | Reading Shop Prints | 2 |
| | | Sub-Total 15 |
| | | TOTAL 29 |

## PLANT EQUIPMENT STUDY OUTLINE

## MECHANIC TRAINEE IIA

I. Clearances

- A. Protective Cards
- B. Hold Orders
- C. Placing of Protective Grounds

II. Switching

- A. Switching Order
- B. Precautions When Switching

III. Water Systems

- A. Definitions
- B. Raw Water System
- C. Potable Water System

IV. Direct Current Systems

- A. Description of Systems
- B. Batteries
  - 1. Types
  - 2. Chargers
- C. Emergency Lighting

V. Excitation Systems

- A. Description
- B. Purpose
- C. Operation

VI. Oil Systems

- A. Uses
- B. Systems
- C. Purification
- E. Storage

## PLANT EQUIPMENT STUDY OUTLINE

## MECHANIC TRAINEE IIB

I. Station Service

- A. Precautions
- B. Description
- C. Operation

II. Power Transformers

- A. Ratings
- B. Purpose
- C. Precautions

III. Governors

- A. Purpose
- B. Type
- C. Operation
  - 1. Oil Pressures
  - 2. PMG
  - 3. Overspeed

IV. Limits, Alarms, and Name Plates

- A. Load Limits
  - 1. Generator
  - 2. Turbine
- B. Temperature Limits
  - 1. Generators
  - 2. Transformers
  - 3. Turbines
- C. Name Plate Data
  - 1. Generators
  - 2. Exciters
  - 3. Transformers
  - 4. Turbines
- D. Annunciation
  - 1. Purpose
  - 2. Description

V. Protective Relays

- A. Description
- B. Purpose
- C. Operation

## CORRESPONDENCE COURSES

## POWER PLANT MECHANIC, TRAINEE IIIA AND IIIB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IIIA** | |
| 6154 | Safety in Welding and Cutting | 1 |
| 6274 A-C | Arc Welding Equipment | 3 |
| 3536 A-B | Arc Welding Techniques | 2 |
| 5250 | Arc Welding of Alloy Steels and Iron | 1 |
| 5249 A-B | Arc Welding of Low Carbon Steel | 2 |
| 5160 | Inspection and Testing of Welds | 1 |
| 2582 A-B | Heat | 2 |
| 2531 A-B | Lubrication | 2 |
| | | Sub-Total 14 |
| | **TRAINEE IIIB** | |
| 2626 A-B | Air Compressors | 2 |
| 5568 B | Bench Work - Part 2 | 1 |
| 3074 A-B | Roofing | 2 |
| 4502 | Drainage Systems | 1 |
| 6732 | Reading Pipe Prints | 1 |
| 5602 A-C | Carpentry | 3 |
| 5887 | Properties of Materials | 1 |
| 6447 A-B | Principles of Heating, Ventilating, and Air Conditioning | 2 |
| 6084 A-B | Air Conditioning Systems | 2 |
| | | Sub-Total 15 |
| | | TOTAL 29 |

## PLANT EQUIPMENT STUDY OUTLINE

## MECHANIC IIIA

I. Safety

- A. Operation of Equipment
  1. Grinder
  2. Lathe
  3. Welder

II. Turbines

A. Type
B. Lubrication
    1. Wicket Gates
    2. Automatic System
C. Operation
    1. Shear Pin
    2. Vacuum Breakers
D. Cavitation
    1. Causes
    2. Methods of Repair
        a. Surface Preparation
        b. Welding Procedures
        c. Grinding Procedures
    3. Safety

III. Bearings

A. Generator
    1. Thrust
    2. Guide
B. Turbine - Guide
C. Lubrication Systems
D. Operation - Temperature Limits

## PLANT EQUIPMENT STUDY OUTLINE

## MECHANIC IIIB

I. Governor

A. Type
B. Construction
C. Method of Operation
    1. PMG
    2. Compressor
    3. Overspeed Mechanism
    4. Oil System
    5. Pilot Valve
    6. Speed Droop Mechanism

II. Air Conditioning, Heating and Ventilating Equipment

A. Operation and Control
    1. Winter
    2. Summer
B. Maintenance

III. Air Compressors

A. Generator Brake System

B. Station Air System Compressors
   1. Cooling
   2. Lubrication
C. Unloader Valves

CORRESPONDENCE COURSES

POWER PLANT MECHANIC, TRAINEE IVA AND IVB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | TRAINEE IVA | |
| 2602 | Bearings and Seals | 1 |
| 2530 A-B | Pumps | 2 |
| 5389 | Tanks and Pumps | 1 |
| 5581 | Pipe-fitting Practices | 1 |
| 6463 | Plumbing and Pipe-fitting Tools | 1 |
| 5886 | Pipes and Fittings | 1 |
| 6814 | Insulation for Pipe Fitting | 1 |
| 6272 | Gas Welding Equipment | 1 |
| 6276 A-C | Gas Welding Techniques | 3 |
| 6275 A-B | Gas Cutting | 2 |
| 5348 | Grinding Practice | 1 |
| | | Sub-Total 15 |
| | TRAINEE IVB | |
| 3520 A-E | Lathes | 5 |
| 5459 A | Fluid Mechanics | 1 |
| 2243 | Gear Calculations | 1 |
| 2606 | Mechanical Power Transmission | 1 |
| 6259 A-F | Rigging | 6 |
| 6235 | Inventory Control | 1 |
| | | Sub-Total 15 |
| | | TOTAL 30 |

PLANT EQUIPMENT STUDY OUTLINE

MECHANIC IVA

I. Clearance Procedures

II. Pumps and Pipe - Fitting in Plant

   A. Types of Pumps
   B. Operating Principles
   C. Pressure Terms

D. Pipe Systems

III. Safety and First Aid

A. Hazards from Painting and Cleaning
B. $CO_2$ Hazards
C. Emergency Breathing Equipment

IV. Welding

A. Types
B. Methods
C. Safety

## PLANT EQUIPMENT STUDY OUTLINE

## MECHANIC TRAINEE IVB

Since this is the "topping out" examination, the study questions for IA, IB, IIA, IIB, IIIA, IVB, and IVA are to be included. Selected questions will be added to this examination to determine the understanding and retention by the trainee of all previous training areas.

I. Water Systems

A. Unwatering Systems
B. Generator Cooling System
C. Water Treatment System

II. Sewage Treatment

A. Type
B. Operation
C. Maintenance

III. Supervisory Skills

A. Record Keeping
B. Planning
C. Responsibilities

IV. Machine Shop

A. Components of Shops
B. Safety Precautions

V. Elements of Rigging

A. Splicing, Seizing, and Whipping
B. Precautions
    1. Safe Loads
    2. Stress in Slings
C. Block and Tackle
    1. Advantages
    2. Disadvantages
D. Definitions

VI. Miscellaneous Electrical and Mechanical

## CORRESPONDENCE COURSES

## OPERATOR TRAINEE IIA AND IIB

| ICS Course No. | Text Titles | Units |
|---|---|---|
| | **TRAINEE IIA** | |
| 6718 B | Hydraulic Turbines | 1 |
| 6589 B | Electric Power Generating Stations | 1 |
| 6634 A-B | Electrical Schematic Diagrams | |
| 2443 | Going Metric | 1 |
| 5567 | Practical Geometry and Trigonometry | 1 |
| 5004 A | Benchwork - Part 1 | 1 |
| 3500 A | Measuring Instruments | 1 |
| 2469 C-E | Algebra | 3 |
| 5011 | Elements of Chemistry (Reference Only) | 1 |
| 2007 A | Solid State Circuits | 1 |
| 6238 A-B | Industrial Accident Prevention | 2 |
| | | Sub-Total 15 |
| | **TRAINEE IIB** | |
| 4030 A-B | D-C Machines | 2 |
| 6687 | D.C. Generators and Motors | 1 |
| 2007 B-C | Solid State Circuits | 1 |
| 6718 C | Hydraulic Turbines | 1 |
| 1842 A-C | Reading Architect's Blueprints | 3 |
| 4031 | Alternators | 1 |
| 3521 A-B | Drilling | 2 |
| 2246 A-B | Erecting | 2 |
| 2542 | Fasteners | 1 |
| | | Sub-Total 15 |
| | | TOTAL 30 |

## PLANT EQUIPMENT STUDY OUTLINE

## OPERATOR TRAINEE IIA

I. Clearance

- A. Protective Cards
- B. Hold Orders
- C. Placing of Protective Grounds

II. Switching

A. Switching Order
B. Precautions When Switching

III. Water Systems

A. Definitions
B. Raw Water System
C. Potable Water System

IV. Direct Current Systems

A. Description of Systems
B. Batteries
    1. Types
    2. Chargers
C. Emergency Lighting

V. Excitation Systems

A. Description
B. Purpose
C. Operation

PLANT EQUIPMENT STUDY OUTLINE

OPERATOR TRAINEE IIB

I. Station Service

A. Precautions
B. Description
C. Operation

II. Power Transformers

A. Ratings
B. Purpose
C. Precautions

III. Governors

A. Purpose
B. Type
C. Operation
    1. Oil Pressures
    2. PMG
    3. Overspeed

IV. Limits, Alarms, and Name Plates

A. Load Limits
B. Temperature Limits
    1. Generators
    2. Transformers
C. Name Place Data
    1. Generators
    2. Exciters
    3. Transformers
D. Annunciation
    1. Description

V. Protective Relays

A. Description
B. Purpose
C. Operation

## CORRESPONDENCE COURSES

## OPERATOR TRAINEE IIIA AND IIIB

| ICS Course No. | Text Title | Units |
|---|---|---|
| | **TRAINEE IIIA** | |
| 6720 A-B | Reading Shop Prints | 1 |
| 4018 A | Principles of A-C Circuits | 1 |
| 4040 | Transformers | 1 |
| 4041 | Transformer Operation | 1 |
| 4042 | Distribution and Power Transformers | 1 |
| 6613 | Switchgear | 1 |
| 4146 A | Electrical Measuring Instruments | 1 |
| 6698 | A-C Motors, Generators, and Rectifiers | 1 |
| 2582 A-B | Heat | 2 |
| 2531 A-B | Lubrication | 2 |
| 6617 | Inductance and Capacitance | 1 |
| | | Sub-Total 14 |
| | **TRAINEE IIIB** | |
| 6699 A-C | Industrial Motor Control | 3 |
| 4358 | Transmission Lines | 1 |
| 4032 | Alternating Current Motors | 1 |
| 5887 | Properties of Materials | 1 |
| 5254 | Logarithms | 1 |
| 6732 | Reading Pipe Prints | 1 |
| 2626 A-B | Air Compressors | 2 |
| 2131 A-B | Digital Methods and Components | 2 |
| 5019 | Fluid Flow | 1 |
| 6308 A-B | Fluid Flow and Control Instruments | 2 |
| | | Sub-Total 15 |
| | | TOTAL 29 |

## PLANT EQUIPMENT STUDY OUTLINE

## OPERATOR IIIA

I. CLEARANCE PROCEDURES

A. Complete Review of Clearance Procedures

II. WATER SYSTEMS

A. Raw Water Uses
B. Unwatering System

C. Treated Water Purification System

III. SELSYN SETS

A. Description
B. Location
C. Operation

IV. DISCONNECT SWITCHES

A. Rating
B. Operation Safety Precautions
C. Maintenance

V. INTERLOCKS

A. Purpose and Types for:
1. Generators
2. Breakers
3. Disconnects
4. Metal Clad Switchgear
5. Control Circuits (Relay, etc.)
6. Governors

VI. ACB's

A. Ratings
B. Operation
C. Maintenance

## PLANT EQUIPMENT STUDY OUTLINE

## OPERATOR TRAINEE IIIB

I. POWER TRANSFORMERS

A. Description
1. $N_2$ Blanket
2. Cooling Systems
3. Alarms

II. INSTRUMENTS AND METERING

A. Purpose and Operation
1. Tachometers
2. Voltmeters
3. Synchroscope
4. Oscillograph
5. Clocks

III. FLOWMETERS

A. Type
B. Operation
C. Maintenance

IV. EXCITATION SYSTEM

A. Excitation System Description
   1. Type
   2. Capacity
B. Generator Field Circuit
   1. Field Discharge Resistor
   2. Field Breaker
C. Pilot Exciter (Some Plants)

V. CODE CALL SYSTEM AND ALARMS

A. Review System and Operation

VI. OCB's/GCB's

A. Description
   1. Control Circuit
   2. Operating Mechanism
B. Operation
C. Maintenance
   1. Breaker Time

## CORRESPONDENCE COURSES

## OPERATOR TRAINEE IVA AND IVB

| ICS Course No. | Test Title | Units |
|---|---|---|
| | TRAINEE IVA | |
| 4502 | Drainage System | 1 |
| 4305 | Lighting Control | 1 |
| 4343 | Storage Batteries | 1 |
| 4368 | Voltage Regulators for Generators | 1 |
| 6538 A-B | Protective Relaying | 2 |
| 4048 | Telemetering | 1 |
| 46793 | Instrument Transformers | 1 |
| 4019 A-B | Electric Power Measurements | 2 |
| 6686 | Local Distribution of Electric Power | 1 |
| 2020 | Basic Electronic Components and Schematics | 1 |
| 2021 | Understanding and Using Electronic Diagrams | 1 |
| 4342 | Efficiency Tests | 1 |
| | | Sub-Total 15 |
| | TRAINEE IVB | |
| 4341 | Industrial Motor Application | 1 |
| 6590 A-B | Electric Power Substations | 2 |
| 2089 A-H | Electronics in Industry | 8 |
| 6235 A | Inventory Control | 1 |
| 6617 | Inductance and Capacitance | 1 |
| 6447 A-B | Principles of HVAC | 2 |
| | | Sub-Total 15 |
| | | TOTAL 30 |

# PLANT EQUIPMENT STUDY OUTLINE

## OPERATOR IVA

I. CLEARANCE PROCEDURES AND SAFETY

A. Review of Clearance Procedures and Safety

II. STORAGE BATTERIES AND CHARGES

A. Storage Battery
   1. Type
   2. Safety
   3. Chemical Action
B. Battery Charger
   1. Type
   2. Source of Power
   3. Trace DC Circuit on Drawing

III. GENERATOR VOLTAGE REGULATOR

A. Type
B. Components
C. Operation
D. Control

IV. RELAYS

A. Types
   1. Differential
   2. Overcurrent
   3. Distance Relays
   4. Directional

V. LIGHTING ARRESTERS AND HIGH VOLTAGE FUSES

A. Description
B. Rating

VI. AIR CONDITIONING, HEATING AND VENTILATING EQUIPMENT

A. Description
B. Operation
   1. Winter
   2. Summer
C. Maintenance

VII. GOVERNORS

A. Purpose and Operation
B. Operation
   1. Echelon Control
   2. Permanent Magnet Generator
   3. Fly Ball Motor
   4. Compensation Cable
   5. Shutdown Solenoid
   6. Speed Droop

# PLANT EQUIPMENT STUDY OUTLINE

## OPERATOR TRAINEE IVB

NOTE: Since this is the "topping out" examination, the study questions for phases 1A, 1B, 2A, 2B, 3A, 3B and 4A are to be included and selected questions will be asked to determine the understanding and retention of all previous training.

I. CARRIER CURRENT

- A. Purpose
- B. Components
- C. Operations
- D. Testing

II. MAIN GENERATOR UNITS

- A. Description
  - 1. Generator
  - 2. Turbine
- B. Operation
  - 1. Starting, Stopping and Loading using a Schematic

III. LOAD, FREQUENCY AND TEMPERATURE RECORDS

- A. Purpose
- B. Operation
  - 1. Generator Field Temperature Recorders
  - 2. Frequency
  - 3. Stator and Transformer Temperature

IV. ANNUNCIATION SYSTEM

- A. Components
  - 1. Relays
  - 2. Trouble Contacts
  - 3. DC Supply
- B. Schematic Diagrams
- C. Maintenance

V. SUPERVISORY SKILLS

- A. Preventative Maintenance Program
- B. Responsibilities Toward Training

VI. TELEMETERING AND REMOTE CONTROL

- A. Purpose

VII. LINE RELAYS AND GROUND DETECTOR SYSTEMS

- A. Line Relays
  - 1. Zones and Protection
- B. Bus Relays
  - 1. Differential
  - 2. Ground
- C. DC Bus
  - 1. Ground Detector

VIII. STATION SERVICE